Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(6): 1941-1943

Received: 17-09-2017
Accepted: 20-10-2017

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An overview on epizootic ulcerative syndrome of fishes in India: A comprehensive report

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Abstract
The present short communication reviews the status of research in India on EUS. It affects thirty genera of fishes in all types of water areas. The incidence percentage was highest in the genera *Channa* and *Puntius* (5-100%). The disease to be more severe (15-70%) in waters of low alkalinity (0-49 ppm) and hardness (0-45 ppm). Heavy metals do not record any metal of significance as predisposing stress factor to fish. Pesticides BHC, DDT, lindane and their metabolites have been detected in water and fish samples and may be important predisposing stress factors. Studies on the suspected causative agents, namely, virus, bacteria and fungus could not establish conclusively the primary etiological agent. So far 20 species of pathogenic bacteria have been isolated from affected fishes of which *A. hydrophila* has been consistent along with the fungus, *Saprolegnia*. Animal parasites like, *Triparticlla, Dactylogyrus, Thelohanellus* are recorded in low intensity.

Keywords: Disease, Eus, Fish, Hemotological Parameters

Introduction
Epizootic ulcerative syndrome (EUS) i s the term generally used to describe a serious epizootic condition o f w i l d and cultured freshwater ffishes whi ch has spread through South-East Asia and extended deep into the Indian sub-continent over the past decade. This syndrome dreaded fish disease of the Asia Pacific region broke out in India for the first time in May 1988 [1] and since then India and the gradual spread of the disease in fresh and brackish water fishes in different states of India. Not any other fish disease in India has been as virulent and menacing as the recent outbreak of epizootic ulcerative syndrome (EUS). The disease affects many species, but losses are most obvious in the snakeheads, *Channa spp*., *Puntius spp*., and i n culture, among the Indian ma jar carps. The problem has been compounded by the fact that many vital clues regarding the causative organisms and other factors responsible for the outbreak of the epizootic are yet to be unravelled. In this present short communication reviews the overview given on epizootic ulcerative syndrome in India.

Incidence of EUS in India
From May 1988 when the disease first appeared in the North eastern states of Tripura, Assam, Meghalaya and West Bengal; it gradually spread to Bihar, Orissa, Uttar Pradesh, Madhya Pradesh, Maharashtra, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Haryana and Rajasthan.

All types of water area in India Fishes have been afflicted by EUS namely, rivers, beels, lakes, irrigation canals, reservoirs and culture ponds. Epizootic ulcerative syndrome (EUS), popularly known as "Red spot Disease" is a dreaded disease of freshwater and estuarine warm water fish causing serious depletion of fish resources due to heavy mortality, and affecting the livelihood of fisher men, as ugly skin lesions distract the consumers. EUS found in several species of fishes. This disease is of complex infectious etiology with the involvement of bacteria, virus, and fungi with conflicting reports about the prime etiological agent. The clinicopathological condition of EUS in fresh water fish has been sparsely studied in India, particularly in the state of West Bengal [17].

Fish species suffer by EUS
Many species of freshwater and brackish water fishes have been recorded in India to be afflicted by EUS out of which four species are exotic and rest indigenous. The cultured species

affected in India are *Calla calla, C;rrhinus mrigala, Labeo rohita, Puntius jalvanicus Ctenopharyngodon ide/la, Hypophtha/mich thys molitrix and Mugil parsla*. The range of incidence of the disease recorded from the different species of infected fish and from different types of water bodies are differant. It shows that certain genera of fishes, such as *Channa, Puntius, Mastocembelus, Mystus, Glossogobius, Anabus, Clarias* and *Heteropeneustes* are highly susceptible to EUS.

Symptoms of EUS

The outbreak of epizootic ulcerative syndrome in fishes of India different but less intense ulcerative condition of varied origin had been reported from fishes by different workers [2-3]. Symptoms of EUS are conspicuously different from the other low level ulcerative condition reported earlier in India. The affected fishes become lethargic, float on the surface of the water sometimes with head projected out of water. Initially the disease appears as red coloured lesions hemorrhagic in nature. Sometimes as in *Wallago attu* it may be in the form of elevated blisters. These red lesions spread and enlarge gradually become deeper and assume the form of ulcers. In acute cases total loss of caudal peduncle is observed and where the lesions affect the head region the cranium is destroyed exposing the brain. Out of this typical acute stages of the disease are observed only in fishes which are capable of surviving under adverse environmental condition such as in *Channa sp* [1]. After further advancement often scales fall off, ulcers become deep hemorrhagic and penetrate muscle layers.

Suspected Mostly Important Causative Factors of EUS

Heavy metal in water

Various water areas shows significantly high values of zinc, copper and mercury were found but do not suggest any perceptible role of the heavy metal content in creating stress to fishes and subsequently predisposing it to EUS outbreak.

Environmental Factors

Mostly the physico-chemical parameters of water and anthropogenic factors SUCA as pesticides, fertilizers and heavy metals play an important role in the out-break of EUS. As suggested by Das [4] at specific water bodies in EUS disease prone area of West Bengal throughout the year and in affected water areas in all the affected state on selected physico-chemical parameters having relevance to the EUS outbreak. It also found that the affected water areas in different states where the intensity of disease was severe had low alkalinity and hardness-a characteristic of acidic low calcium soils. The observation is in agreement with earlier outbreak reports [5] from other countries affected by EUS that low alkalinity, hardness, chloride concentration and fluctuating pH showed a-link-with EUS.

In India besides such highly susceptible area EUS outbreak also occurred in water areas which has high alkalinity and hardness but with lesser in intensity. Studies carried out at disease prone site in West Bengal [6] shows that EUS outbreak does not commence during the monsoon period. The disease outbreak occurs at the time of waning of rainfall and onset 'of gradual stagnation from September and fall in water temperature and minimum air temperatures. Also sudden fall in the hardness of water from the higher summer values due to dilution during rainy season which is to be another predisposing factor for triggering the disease outbreak.

Agrochemicals and Pesticide

Most of the outbreaks of EUS in India occurred after rainfall. Occurrence of EUS is high in rice field environments in India. The EUS occurred pesticides were suspected to be associated with this outbreak. This observation is in agreement with reports from other countries leading to suspicions that drainages of agricultural chemicals may have an important role as predisposing factor for EUS outbreak [8]. Analyses of pesticide residue in water, fish and plankton of some specific EUS affected water areas in India were studied [6, 9] to assess the relation between pesticide use and EUS outbreak. Their studies shows that there is occasionally higher concentrations of organochlorine and organophosphorus pesticides have been found in water and fish samples, no correlation can be made with the presence of pesticide residue and disease outbreak. Studies conducted by Kurup [9] in the Kuttanad aquatic ecosystem in Kerala where EUS outbreak occurred revealed that indiscriminate pesticide application for paddy cultivation have create a water pollution problem. High concentration of DDT and its metabolites DDE and DDD were present in in the range in some stations being 12,000-22,000 ng/l. The range of endosulfan values registered is 66- 1,114 ng/liter. The sublethal values of DDT and for fish was 10000 ng/liter. There study indicated that the extent of pollution create a stressed condition for aquatic life and may be the predisposing factor for EUS outbreak. It is widely suspected that a biological infectious agent is the primary cause of EUS and certain abiotic factors are responsible for creating stress to fish. The biological agents affecting them are viral, bacterial, fungal and other animal parasites.

Virus

Virological studies on the EUS affected fishes in India by Sitdhi [10] of EUS affected fishes, namely, *C. idella, Colisa sp., P. javanicus, H. molitrix* and *P. sophore* from Assam, *C. calla* and *C. carpio* from Tripura, *C. punctatus, M. armats, N. nandus, P. sophore* from West Bengal, showed no cytopathic effects on snakehead cell line up to 14 days when tissue extracts (spleen, liver, gills and ulcerated parts) were inoculated. Their monolayer of snakehead cells in the control and inoculated flasks were the same. The electron microscopy studies for occurrence of viral agents in the kidney and liver showed negative results. Kumar [13] reported that EUS affected fish genera *of Channa, Puntius* and *Mastocembelus* showed initial positive indications. These affected fishes when injected in confluent cultures of BB, FHH, EPC cell lines showed CPE within three to seven days in culture. In all cases spherical virus like particles were visualized which await detailed characterisation. Though a primary viral aetiology has been considered a likely possibility given the rapid and uncontrollable spread of EUS and its distinct clinical sign. [5, 10] However, from the extensive study conducted on viral aetiology of EUS in different countries, Frerichs [12] opined that although seemingly frequent isolation of rhabdovirus might at first sight present an after active proposal for casual agent, it should be realized that the virus has never been isolated from more than 5% of diseased fish examined.

Bacteria

Several workers. [9, 10, 11, 13, 14, 15, 16] studies on the bacterial pathogens from EUS affected fishes. These workers isolated a wide variety of pathogenic bacterial forms from lesions and

other internal organs such as gills, kidney and liver. A study conducted by Biswas *et al*. [17] based on 67 water bodies of Gangetic alluvial zone of West Bengal, India, revealed the incidence of EUS in 15 (22%) water bodies. That incidences in culture ponds, public ponds, and water pools were 13.63%, 23.07%, and 50.00% respectively. The difference was non-significant ($P \geq 0.05$). EUS was found in thirteen species of fishes *viz., Channa spp., Puntius spp., Cirrhinus mrigala, Labeo bata, Mystus spp., Anabus testudineus, Puntius javanicus, Mastacembelus spp., Notopterus spp., Clarias spp., Cyprinus carpio, Catla catla* and *Labeo rohita* with the highest incidence in *Channa sp*. (89%), followed by *Puntius sp*. (61%), *Labeo bata* (54%), and *Cirrhinus mrigala* (51%). Clinical examination primary skin lesions, haemorrhagic skin lesions, raised haemorrhagic skin lesions, open ulcers surrounded by haemorrhagic patches, and healed open ulcers. The infection rate in young fishes (38%) was higher than the adults (33%). Bacterial pathogens were isolated from 21 samples (22.34%) from the cultures of 94 samples of blood, muscle, and visceral organs (kidney and liver) of EUS affected fishes. The incidences of *Aeromonas, Pseudomonas, Staphylococcus* and *Escherichia coli* in pure cultures were 17.18%, 6.25%, 5.26%, and 5.26% respectively. The isolates from blood, muscle, kidney, and liver were 26.0%, 23.6%, 21.0%, and 14.2% respectively. There is no significant relationship between the forms of bacteria isolated and a particular species of diseased fish or a location of disease outbreak. In India and in other countries the predominant bacterial form isolated is *Aeromonas hydrophila*. Lilley [5] studied that the absence of any hemorrhagic septicaemia characteristic of *Aeromonas* infections in all but the most ulcerated fish suggest that *A. hydrophila* is unlikely to have any primary infective role. Indeed *A. hydrophila* granuloma formations were found [11]. Livers of affected fishes did not show any significant change except vacuolization in certain cases [7]. However, Kumar [11] observed most of the sinusoidal space and blood vessels were congested (hyperaemia) and wandering lymphocytes were plenty in liver parenchyma. No changes were observed in kidney of affected fishes. Haematological parameters of affected fishes showed higher counts of phagocytic cells and reflected initiation of defence phagocytosis in blood circulation. The decline in counts of erythrocytes (RBC) followed by drop in haemoglobin (Hb) content and hematocrit (HCT) values indicated anaemia condition [7].

Conclusion

In these fishes histopathological studies show granulomatous formations in dermis. Liver and kidney do not show any significant histological change. Haemotological parameters of affected fishes reflect higher counts of phagocytic cells and drop in haemoglobin and hematocrit values.

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